C18/A.

JULY

THE MGA BULLETIN

1946

No. 4

ORGAN OF THE MUSHROOM GROWERS' ASSOCIATION

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PRICE 2/6

THIS BULLETIN IS CONFIDENTIAL TO MEMBERS

THE MUSHROOM GROWERS' ASSOCIATION

NEW FULL MEMBERS

Since 1st MARCH, 1946

★

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[continued on inside back cover]

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THE

JULY 1946

BULLETIN

No. 4

EDITORIAL OFFICE: HIGHFIELD, BRAYTON, SELBY, YORKS.

EDITORIAL

RESEARCH

The minds of several members are being exercised over the issues of major research. The Mushroom Research Association (page 22) has elected to give priority to the investigations into Synthetic Compost, while Mr. Luxmoore (page 20) and others want the more immediate problems of diseases etc. solved.

My own sympathy, as a director of the Mushroom Research Association, lies naturally with the former group, but as editor of your Bulletin, I shall allow no personal bias to interfere with the free expression of opinion in these pages. Indeed I regard the Bulletin as the only means by which a scattered industry can ventilate the " give and take " of constructive controversy, and we not only welcome but invite all opinions on research or any mutually important topic.

Incidentally, some of the misunderstandings which have arisen concerning the new Station at Yaxley should be cleared up by the articles and announcements in this issue.

* * * * *

M.G.A. PROGRESS

The Association's activities are covering an ever-widening field, and it is gratifying to learn from our dauntless Secretary that the M.G.A. is becoming officially recognised as the mouthpiece of a not unimportant branch of Horticulture. With complete and full recognition we shall have achieved one of our aims.

Such progress coincides with a steadily increasing number of members —30 new full and 13 new Hon. members in the last quarter ; with the announcement of a reference library which, though small at present, is being built up as quickly as prevailing conditions will allow ; and with the rapid increase in the size of the Bulletin from an eight page leaflet last October to 36 pages to-day.

These and other signs of healthy progress are most encouraging.

Many people, members and others, are working for us. The few who are against us appear reluctant to voice their criticism of our movement. Will members who come up against such opposition please " go on talking."

Please address all communications to the Editor

NEWS FROM M.G.A. HEADQUARTERS

★

THE MAY EXECUTIVE MEETING

ANNUAL GENERAL MEETING

THE May meeting of the Executive Committee was of unusual interest, and several items on the Agenda might usefully be discussed on this page.

We decided to hold the first Annual General Meeting in London at the end of November and as most members attending will require a meal, the suggestion was adopted that we introduced the meeting with a Luncheon, at which one or two brief speeches would be made by distinguished guests. All members, honorary as well as full, are urged to attend both luncheon and meeting, and are invited to bring with them their fellow Directors, Partners and Managers. Printed cards are enclosed with this Bulletin so that you may let me know as promptly as possible how many of you expect to be present. I can then make the necessary arrangements in good time. Full details will be given in the next Bulletin, BUT PLEASE POST YOUR CARDS BEFORE THE END OF THIS MONTH.

GUEST OF HONOUR

We are very fortunate in that Dr. V. E. Wilkins has accepted our invitation to attend the Luncheon as Guest of Honour. Dr. Wilkins is " in charge of Horticulture " at the Ministry of Agriculture, and presides over the new permanent Horticultural Liaison Committee. Welcoming his appointment in February, " *The Grower* " said : " For the first time all the threads of horticultural relations leading from the grower to Whitehall now end in the hands of a single individual, instead of being scattered through a series of offices and corridors." All will be interested in what Dr. Wilkins will have to say to " the unrecognised industry." There will be a nominal charge per head.

HALF-WAY SUBSCRIPTIONS

Membership continues to rise satisfactorily. We now have 125 full members, 39 honorary, and 4 honorary (Educational/Advisory).

The current financial year has been extended to 31st October instead of 30th August), in order to conform to the Union's year. No member is likely to object to this alteration—and our Treasurer is much happier.

It was also decided that growers who join half way through the year shall come in for half the annual subscription. They will, of course, receive subsequent Bulletins and publications free of charge, but will have to purchase previous copies if they want them.

NO MINISTRY FOR PACKERS

A picker is officially regarded as an essential employee on a farm, but a packer is not !

This peculiar distinction was reported in connection with a member's application to the Ministry of Agriculture for the release from the A.T.S. of his head packer. The answer was " No." ; the member appealed to the M.G.A. ; we took the case to the Union ; and the Union reported back to this effect :

> The Ministry of Agriculture were not in a position to sponsor the application as their jurisdiction ceased with the harvesting, and the question of a packer therefore had to be dealt with by the Ministry of Food. The Ministry of Food could not sponsor the application since mushrooms were not a product over which they exercised control ! Without support from either Ministry, no release was possible.

I believe we have the moral support of every member in taking this case further, and it has now been reported to Mr. Haynes as yet another example of the difficulties we face.

TRAFFIC EMBARGOES

Spasmodic rail embargoes on manure traffic which caused so much concern to our members last winter were again the subject of discussion at the Glasshouse Committee in April. Mr. Hovell voiced our feelings, and the Secretary of the Transport Committee has provided what is considered by the M.G.A. Executive to be a satisfactory reply. This concludes :

> " It is not likely that the transport situation next winter will be anything like as severe as last, and the Railway Companies may not be required to restrict in the same way the volume of traffic accepted for conveyance. I will, however, take an opportunity during the early autumn of raising this subject again with the Ministry of Agriculture and the Ministry of Transport with a view of fertilisers and manures being given a higher priority in the event of the necessity of imposing railway traffic restrictions."

REFERENCE LIBRARY

The establishment of our own Reference Library was formally announced. Much interest was aroused by my suggestion last quarter that such a Library would serve a useful purpose—as indeed I think it will.

Few members have so far sent along books or papers, but I believe the acute shortage of technical works, and the fact that they are at present irreplaceable, explain this. There are enough books to make a useful start, however ; and our list will be augmented at every opportunity.

IMPORTS

Our " case " based on the Government's decision to permit the importation of mushrooms from the Continent was sympathetically considered by the N.F.U. on 27th March.

On 16th April, I attended a meeting of the Horticultural Liaison Committee at Africa House, and was supported " up to the hilt " by the Union's representatives.

Dr. Wilkins and his Committee listened attentively to what was said on the Association's behalf, asked for further details in writing, and promised to give the matter " full consideration."

I am to attend a later meeting to receive their comments.

THE VICE-CHAIRMAN

The portrait this quarter is that of our Vice-Chairman, Mr. Stanley Middlebrook, who somehow finds time to edit this Bulletin. The photograph fails to provide an exact likeness because Mr. Middlebrook's pipe is as much a part of him as his astonishing energy and keeness. I spent a recent weekend with him. He met me with : " How are the mushrooms ?"—and 48 hours later said goodbye with : " Well, here's to better breaks!" Apart from the little sleep permitted me, he had not ceased to range vigorously and untiringly over the whole field of mushroom problems.

This enterprising grower was the first paid-up member of the M.G.A., and we are fortunate in having harnessed so early his tremendous enthusiasm.

MORE MEMBERS WANTED

A circular letter went out in April telling all growers outside the M.G.A. how the Association was watching the Imports situation. In consequence of this propaganda we are able to welcome more than 20 new members who were considerate enough to wish to contribute towards our efforts.

If I confess I did not expect a membership of more than 50 in our first year, and admit much satisfaction that this early hope has been more than doubly fulfilled, shall I be considered insatiable if I appeal to each individual member to go out of his way during the last few months of the current year to enrol one more member ? A membership of 250 would enable us to speak much more forcibly than is possible with 125 members—though I must add that when I make representations to the Union or to the Ministry of Agriculture, I am regarded by both as speaking for the Industry. This is a most important achievement for which every member can take his share of credit. Let us get more and more members—for in numbers lies our strength. And strength we shall indubitably be needing in the months to come.

FRED. C. ATKINS.

ITEMS OF GENERAL INTEREST

44. **World Contacts.** The N.F.U. is endeavouring to establish contacts with State Agricultural Departments all over the world, and any important information relating to mushrooms which comes to hand will be passed on to our members through this Bulletin.

* * * * *

45. **Nationalization.** The Union " has not heard of any suggestions for the nationalisation of the land by the present Government in the immediate future."

* * * * *

46. **A Tax relief for Farm Workers.** The Union understands that, as a result of an arrangement made some time ago between the N.U.A.W. and the Board of Inland Revenue, farm workers may obtain additional taxation relief of £4 per annum in respect of special types of farm clothing. It is understood that this extra allowance, which is of a concessional nature, will be made available to all farm workers upon application to their local Inspectors of Taxes. Farmers are asked, therefore, to bring this arrangement to the notice of all their employees in order that they shall obtain the maximum possible amount of relief from taxation. —N.F.U. RECORD, April, 1946.

* * * * *

47. **Maintenance Only ?** " As I understand the policy of the Ministry, it is to allow no new glasshouses to be erected, but to ensure that the 1939 area of glass be maintained in a reasonable state of repair. The permits necessary to ensure this policy are supported by the County W.A.E.C.'s." —"G. C. SOMERSET," in *The Grower.*

* * * * *

48. **Horticulture to be Recognised.** In the reconstruction plans so far made public, horticulture is to receive separate treatment in schemes for Education, Advice and Research, and recognition on many committees for administration purposes.—DR. H. V. TAYLOR, in the *Fruit Grower.*

* * * * *

49. **Mr. F. A. Secrett,** commenting in the " *Fruit Grower* " on future horticultural research, suggests concentration on " growing varieties of plants free from pest and disease, contrary to the general practice of attempting to remedy the evils already existing in diseased plants. Prevention is always better then cure . . . . . "

* * * * *

50. **Artificial Compost,** prepared from wheat straw does not compare favourably with composted stable manure for mushroom work. It often produces a good first flush, but the crop does not last very long. —The *Fruit Grower* answers a correspondent.

* * * * *

51. **More Imports.** Mushrooms by the ton may soon be coming from the Channel Islands—grown in the vast concrete-lined tunnels which slave workers constructed for the Germans. " All that is required is a layer of compost," a Jersey market gardener tells a *Daily Mirror* reporter.

A REFERENCE LIBRARY FOR MEMBERS

A REFERENCE LIBRARY FOR MEMBERS has been established at Association Headquarters and should prove a useful adjunct to our activities.

All the books and papers listed below may be borrowed through the post, but members are asked to exercise care in their packing and to register them, because most are irreplacable today.

The thanks of the Association are due particularly to five donors whose generosity made this Library project feasible: The U.S. Department of Agriculture, Bureau of Plant Industry; Mr. Middlebrook; Dr. Ware; Messrs. Noble Mushrooms Ltd.; and Dr. Lininger, Director of Pennsylvania State College.

LIBRARY DONATIONS

MR. FRED. C. ATKINS presented :—

Verticillium on Mushrooms. —*F. C. Atkins*

THE U.S. BUREAU OF PLANT INDUSTRY presented :—

Principles and Problems of Mushroom Culture. —*E. B. Lambert*
Studies on the Preparation of Mushroom Compost. —*E. B. Lambert*
Indoor Composting for Mushroom Culture. —*E. B. Lambert*
Air-Conditioning Requirements in Modern Mushroom Houses. —*E. B. Lambert*
Effect of Excess Carbon Dioxide on Growing Mushrooms. —*E. B. Lambert*
Size and Arrangement of Plots for Yield Tests with Cultivated Mushrooms. —*E. B. Lambert*
Mushroom Growing in the United States. —*E. B. Lambert*
Mushroom Casing Soil in relation to yield. —*E. B. Lambert & H. Humfield*
Distribution of Oxygen and Carbon Dioxide in Mushroom Heaps as affecting microbial thermogenesis, acidity and moisture therein. —*E. B. Lambert & A. C. Davis*

DR. F. F. LININGER presented :—

Mushroom Insects their Biology and Control —*C. A. Thomas*
Control of Mushroom Diseases and Weed Fungi. —*W. S. Beach*

THE MIDLANDS GROUP OF MUSHROOM GROWERS presented :—

1945 Year Book for Mushroom Growers.

MIDLANDS GROUP PUBLICATIONS presented :—

1945 Year Book for Mushroom Growers.
Verticillium on Mushrooms. —*F. C. Atkins*

MR. P. A. MOLTESEN,
Danish Agricultural Attache in London, presented :—
Nutrition of the Cultivated Mushroom. —*C. Treschow*

GEO. MUNRO LTD. presented :—
The Culture of Mushrooms. —*Geo. Munro Ltd.*

MR. STANLEY MIDDLEBROOK presented :—
Microbes by the Million. —*H. Nicol*
The Cultivation of Mushrooms. —*Bewley & Harnett*
Mushroom Growing (1935). —*W. M. Ware*
Mushroom Growing in the United States (1935). —*W. M. Ware*
Edible Fungi. —*J. Ramsbottom*
Applied Mycology and Bacteriology. —*L. D. Galloway & R. Burgess*
Mushrooms. —*Miss D. M. Cayley*
British Fungi and Lichens. —*G. Massee*

NOBLE MUSHROOMS LTD. presented :—
Mushroom Pests and their Control. —*A. C. Davis*
Mushroom Growing in the United States. —*E. B. Lambert*
Disease of Cultivated Mushrooms caused by Verticillium malthousei nov. sp. —*W. M. Ware*

DR. W. M. WARE presented :—
Disease of Cultivated Mushrooms caused by Verticillium malthousei nov. sp. —*W. M. Ware*
Plaster Moulds in Mushroom Beds. —*W. M. Ware*
Clitopilus Cretatus as an Invader of Mushroom Beds. —*W. M. Ware*

Also obtained, mostly by purchase :—
M.G.A. Bulletin, One (2 copies).
M.G.A. Bulletin, Two (2 copies).
M.G.A. Bulletin, Three (2 copies).
Nutritive Values (2 copies). —*Medical Research Council*
Edible and Poisonous Fungi (2 copies). —*Miss E. M. Wakefield*
Diseases of Crop Plants (2 copies). —*W. C. Moore*
Report of the Delegates N.F.U. Tour of U.S.A. and Canada (2 copies). —*G. A. Nott & R. A. Templeton*
Horticultural Industry in the Dominions and U.S.A. —*Giles Tuker*

The next Bulletin is due to appear on 1st October. Correspondence, articles, photographs, advertisements, etc., should be sent in not later than 15th August.

* * * * *

Copies of our 2nd Bulletin published on 1st January, were exhausted in three months and growers enrolled since March could not be supplied. If any honorary members have copies which are of no further use to them, the Secretary would be grateful for the opportunity of passing them on to members at present without one. This miscalculation is not likely to recur.

CORRESPONDENCE

From **Dr. J. W. SINDEN,** Pennsylvania School of Agriculture, U.S.A. :

" Verticillium is a disease which is apparently much more of a problem with you than with us. We are, of course, not free from it ; but usually, until nearly the end of the crop, the loss from it is inconsequential."

* * * * *

From **M. C. LUXMOORE** :—

". . . . Thank you very much for the offer of help. We growers are so unused to aid from another competitor that it never struck me that the M.G.A. would help . . . . .

" I recently had an excellent flush of ·27 lb. per sq. ft. I am sceptical about the ·5 lb. I've seen quoted in the Bulletin."

* * * * *

From **M. N. GRIFFITH** :—

" We trust the Association will be successful in the (Importation of Mushrooms) fight for the growers. We fully appreciate the danger. The Government policy in this matter—as in much else !—is past understanding."

* * * * *

From **C. E. HILL** :—

" I feel strongly that we want more scientific work in the industry—something to help us fight Pests and Diseases, which almost every grower comes up against."

* * * * *

From **E. DAEPP** :—

" I intend to go back to Switzerland in May, and have some experiments in mind which, if successful, would mean a revolution in the mushroom trade. I will report from time to time to the M.G.A. about what is going on among mushroom growers in Switzerland and the neighbouring countries."

* * * * *

From **W. A. B. HARDING** on *Farm Visits* :—

" I should be pleased to co-operate . . . . and offer an open invitation to Association members, but to visitors outside the Association I would ask a small charge of 10/- to discourage the " merely curious " . . . . I have no crops to demonstrate at the moment, but intending growers might be interested to see my new plant under construction and a few of the expedients employed in solving the present difficulties."

* * * * *

THE N.F.U. GROWS

The rapid expansion which has taken place within the last two years is adequate testimony to the effectiveness of the National Farmers' Union.

—H. R. HAYNES in the *Fruit Grower.*

THE MUSHROOM GROWERS' ASSOCIATION

ANNOUNCES

There is a misunderstanding over the new Yaxley Research Station. This Station is NOT run by the Growers' Association—nor could it be, with 125 members at the present subscription of £3 3s. p.a. What the M.G.A. IS doing is to encourage research generally, both at existing and projected Stations. How this encouragement can be made more effective will be a subject for discussion at the First Annual Meeting.

THE MUSHROOM RESEARCH ASSOCIATION

ANNOUNCES

(By courtesy of the M.G.A.)

It is in no way connected with the Growers' Association. It is a company limited by guarantee and financed by growers who are convinced that immediate, full-time research is essential to their future. All mushroom growers in the country have been invited to subscribe, and it has been decided that the results shall be available only to those who accept this invitation. Subscriptions are at present based on the pro rata basis of £15 per 1,000 sq. ft. of available cropping area.

(See Mr. Atkins' Notes on Page 24)

A Yorkshire Member's OPEN DAY

A demonstration of Commercial Mushroom Culture, with special reference to trials with DDT and Gammexane, was held on the farm of Messrs. N. W. & H. H. Fell at Barkston Ash, on 3rd June, 1946.

This is the first instance within my knowledge of a mushroom farm being "open" to the inspection of competitors and others.

The insecticide tests and the demonstration were made in conjunction with the Horticultural Sub-Committee (Technical Dept.) of the West Riding W.A.E.C., and were fully outlined and explained by Mr. H. Ward, Area Horticultural Advisory Officer. Some 60 or 70 growers attended and Mr. Norman Fell very ably detailed his methods of production. He is to be complimented on his free offering of the hints and so-called "secret processes" of production. He grows nothing but "browns" and claims that taken all round, they are a better financial proposition than "whites," being more prolific and more resistant to disease.

Many questions concerning practical cultivation were asked and fully answered, and he dealt convincingly with the surprise expressed by some growers at his preference for ground beds. The Fell Bros. do not "force" unduly and crops treated only once with Gammexane or DDT were showing remarkably little fly despite the passage of several months since the application. The few flies present were crawling on the beds in a stupified state and there was no maggot infestation. There were no flies on the wing.

It is to be hoped that more such "open" days may be arranged; for the interchange of ideas, sharing of problems, and mutual assistance can bring nothing but good to the industry. S.M.

PAYMENT FOR ARTICLES

Articles in this and future issues of the M.G.A. Bulletin will be paid for at the rate of a guinea per full page.

M. G. A.

THE

FIRST ANNUAL LUNCHEON

AND

GENERAL MEETING

will be held at the

HOLBORN RESTAURANT

HIGH HOLBORN, LONDON, W.C.

On FRIDAY, 29th NOVEMBER, 1946

12-30 p.m. to 4-30 p.m.

MUTUAL AID

Members Ask Your Advice

Please send replies to the Editor, M.G.A. Bulletin, Highfield, Brayton, Selby, Yorks.

Q 29 Could you inform me what Glacial Acetic Acid is used for in mushroom growing?

Q 30. I would be glad if you would let me know what you consider the best fumigant for mushroom flies.

Q 31. An ex-Serviceman has asked me how much capital is required to set up as a mushroom grower. Can any member help me to answer this question?

Q 32. Spraying the immediate vicinity with 2% formalin is failing to keep in check an attack of Dactylium. What more can I do?

Q 33. What are the ideal ratios of air space to bed space in timber, asbestos and brick houses?

Answers to Previous Questions

Q 23. **Use of Cuprinol.** A Cuprinol representative states it will definitely kill the eggs of any wood-boring insect, but will not commit himself on whether it will kill the eggs of mushroom fly. Even if creosote does this initially, it is soluble in water, and the toxicity would quickly be reduced. He claims that bedboards once treated with Cuprinol will last at least 10 years. (F.C.A.)

Q 24. **Composting wide heaps.** A wide heap is a great mistake, causing anaerobic fermentation at the bottom centre. Use for preference a narrower heap with more outside. Perhaps you have added excess water during the early turns, thus failing to produce the desired fermentation. If the moisture content is not correct allow less interval between the first two turns, adding water if dry during the second turn, or if wet allowing the moisture to evaporate and adding a little extra gypsum to reduce the excess. Three weeks and three turns are sufficient for "making" the present quality of "heavy" manure. (W.A.B.H.)

Q 25. **12 weeks manure collection.** Avoid it. Six weeks is long enough. (W.A.B.H.)

Q 26. **Site pollution.** Is your trouble with indoor or outdoor culture, and on shelf or ground beds? With ground beds the old site must be thoroughly sterilized with formaldehyde to a depth of at least 3". It is generally recognised that with outdoor culture the same site cannot be used more than once in 3 years. In the case of shelf culture in dark houses, most long-established growers have found a remedy by inserting windows to admit reasonable sunlight and the natural cultural elements. (W.A.B.H.)

Q 27. **Stroma.** If you are certain the soil is moist at the point of contact with the compost, and uniformly upwards, splash heavy water on the stroma and ventilate fully. (S.M.)

Q 28. **Lightweight Mushrooms.** A high air temperature and dry beds will produce lanky and featherweight mushrooms. Try cooler and more humid conditions to reduce forcing. (W.A.B.H.)
I suggest the base of the soil layer may be dry and the growth is from insufficiently moistened root formation. (S.M.)

(*We regret that several questions have to be held over for lack of space*)

EXTRACTS FROM

A Mushroom Grower's Diary

5th April. Dr. Peet, in the April Bulletin, says that a single gravid female can deposit up to a thousand eggs. This surprises me, as I recently watched an eminent University Entomologist examine a gravid female phorid under the microscope. With entomological care he burst open the body, and we counted only 23 eggs. He informed me that 20 to 30 is the usual number for the phorid. Perhaps Dr. Peet was referring to the Sciarid, which may produce more—I don't know.

6th April. Small boy on way home from school :—" Give me a mushroom, Mister." When asked why, he said he wanted to plant it in his garden. Again I asked why. His reply was all-satisfying – " Teacher says."

8th April. Asked my friend George to join the M.G.A.

10th April. I learn that spawn that has been retarded by freezing (presumably in the laboratory) will throw up a stroma. Personally I disagree, because I think stroma is caused when one fails, knowingly or otherwise, to arrest the upward growth of mycelium.

11th April. A compost turned yesterday is covered with flies today. Powdered it with Gammexane this morning. Four hours late no fly to be seen anywhere, but thousands of living maggots have come to the surface.

12th April. The maggots are now dead.

14th. Asked George again. Told him about Imports.

16th April. A daughter of the late William James, American Psychologist and Philosopher, recorded that after eating mushrooms for lunch she, her mother, and a visiting dressmaker were overcome by a desire to sing and dance.—*Strand Magazine.*

29th April. I hear of more growers getting winter control by Gammexane and D.D.T. One grower, for long under a cloud of Verticillium, is now getting 5 disease-free flushes instead of 2 or 3. He attributes the improvement to " less fly."

2nd May. George asks, " What do I get out of it ?" I told him.

5th May. All spores, I am told today, are of the same specific gravity as either air or water, for by these agents they are disseminated for propagation.

6th May. I suppose it is true that compost on ground beds comes out as moist as it goes in and that the casing of such beds needs less water. Tier bed growers have a much bigger problem in attempting moisture uniformity in, say, 5 tiers.

8th May. " Much ado about nothing " is one grower's comment on heating up after filling. He says his crops are no worse since he stopped heating up. He now spawns immediately after filling and saves at least a week.

12th May. George is thinking it over.

20th May. Gammexane appears to be giving complete control of fly. The routine is so simple. Sometimes I think it is too easy to be

true. 1. Powder after Filling. 2. Powder after Casing. That's all! (So far, at any rate). Some weeks ago I filled a house and omitted to powder it right away. Result : compost full of flies—the first seen since Gammexane was introduced to this plant last October. I dashed in with the spray and four hours later no fly was to be seen, nor has any been seen to this day. The fact is flies don't like Gammexane and Gammexane stays for a long time. Using Gammexane in this fashion I have no opportunity to try out the latest D.D.T. concoctions.

23rd May. A neighbour—Gammexane-minded—has no mites. Somewhat puzzled by this, because I have mites in some houses, I asked him the answer. " Gammexane," he said, " but you must wait a week or two for results."

24th May. I've tried for years to find some improvement as a result of bottom ventilation. It always eludes me.

25th May. George still thinking. Thinks hard, George does ! Told him about the Annual General Meeting.

28th May. For some months I have been controlling compost moisture during the curing period by having the stacks packed loosely or tightly according to requirements. No water has been added at all. The coming of warmer weather has upset my calculations, and the measure for moisture retention—hard tramping—hasn't worked too well, so I've had temporarily to reinstate the hose. Heavy additions of unwetted straw have not helped, but even so I shall in future try still harder tramping in preference to adding water.

29th May. Three mushrooms affected by verticillium today. For months I've been free from this disease and I attribute its reappearance to a changed watering system which automatically raises the humidity.

30th May. George phoned. He's taking steps . . . . .

31st May. In common with some other growers I have received my sample D.D.T. " bomb." Says the accompanying leaflet : " A mixture of D.D.T. with certain chemicals to form a compound which when ignited volatises the D.D.T. giving it off in the form of a dense white vapour that penetrates every crevice . . . . . does not stain metals or fabrics and except in very heavy concentrations, is not harmful to humans or animals."

2nd June. George calls an extraordinary meeting of his directors to work out whether membership of the M.G.A. is worth 10 lbs. of mushrooms !

3rd June. An amateur having a surplus of Cropost material after making up his compost, threw it on a large square of his lawn. Everything appeared to die off, but within a few days he had a lovely turf—the weeds had gone !

4th June. The 4th flush of a synthetic compost is just showing and seems very promising. The first three suffered from underwatering and much of the packed growth in the casing failed to mature. It's very important to realise that this synthetic would have been abandoned as hopeless but for a change in the moisture treatment.

8th June. Told George about the luncheon at the Annual General Meeting. George joins the M.G.A. Victory Day !

HORTICULTURAL TRAINING IN EASTERN COMMAND

MUSHROOMS INCLUDED

BY

LIEUT-COLONEL W. E. SHEWELL-COOPER, F.L.S., N.D.H., F.R.S.A.

Command Horticultural Officer, Eastern Command

IN the first place, I am not going to set myself up as a Mushroom Expert, though as a matter of fact, I do not think anyone would dare do that today. There is a tremendous amount as yet to be learned about mushroom growing, and I feel sure that in 10 years time we shall wonder why we were such fools in 1946. I am, however, delighted that the Mushroom Growers' Association should have been started, and I would like to take this opportunity of congratulating the Editor on this excellent Magazine. It is well produced, full of information, and very readable.

The general aim of the Welfare Horticultural Department, whose home is the Horticultural Training Centre, Arreton House, Maidstone, is to see that the men are happy, and that they are provided with the help they need. There has been a tremendous amount of interest shown in horticulture by the soldiers, and this interest has by no means been confined to the lower ranks. In fact, one can say that the keenest are often the Officers at the highest levels.

It is, I think, impossible to teach mushroom growing by a series of lectures. You may tell a man what a mushroom compost should look like when it is ready to make up into its bed ; you may push into his hand (if you can get hold of a copy) Dr. Ware's excellent book, but the only way to learn how to grow mushrooms is to do it, for it is when you do it that you find out the snags. I have had the bitter experience of doing everything in accordance with the book ; of taking infinite trouble to use the right casing soil ; of making certain that the pH. is right, the moisture content correct, the heat in the house O.K., and then found that for some reason or other all the beds are rotten with Tyroglyphidae and Linopodes. These mites can be devastating, and the year I had them so badly I never did find the perfect method of control. It may be that D.D.T. would help, but I am speaking without the book.

All therefore that we have attempted to do is to use the Eye-gate, and on " Open Days " we have had enlarged photographs of mushroom houses, mushroom beds, mushroom pests, as well as exhibits of mushroom spawn, properly prepared compost, examples of casing soil, and so on. The men have had short talks on the subject from experts like Mr. Gahm of Darlingtons, and we have tried to further the right type of knowledge by providing leaflets and booklets on the subject. You see, all that you can do with a man or woman, very often, is just to put them on

the right road ; to tell them about sterilised spawn and the reason for it ; to discuss with them synthetic composts and the use of horse manure ; to make them realise that mushroom growing isn't that easy get-rich-quick stunt which some of the racketeers try and make out ; tell them of the Mushroom Growers' Association and the value it will be to them if they intend to start up. It is this kind of thing that we can do for the fellows in the Army which will save them many a headache later on.

Then in addition to this, there is the actual Course. For this purpose we had the perfect co-operation between Dr. W. M. Ware of the South Eastern Agricultural College and Mr. George V. Allen the Mushroom Grower, of Bilting. Dr. Ware had been a Home Guard Officer in the Command, and Mr. Allen a Lieutenant in a Unit serving in the Command, so they had every sympathy with our project. Dr. Ware dealt with the Lecturing side, showing them photographs with his epidiascope, and slides with his lantern. He dealt with the general principles of mushroom cultivation, and later of course, discussed diseases and pests.

Mr. Allen got down to the practical side. He showed the officers and men how the manure must be mixed and turned. He showed them how to mix Gypsum with the manure ; he took them to the beds made up, and dealt in detail with the temperatures ; showed them how to pick, how to water, and of course later on, how to grade and pack for market. The way Mr. Allen tackled the subject was admirable. He is the ideal demonstrator, and I would like to give him full marks for the unselfish way in which he gave up his time and put his mushroom farm at our disposal.

General Sir Oliver Leese, the G.O.C. in C. himself came on the Course with Major-General Miles, commanding the South Eastern District, and there is no doubt that this is the way to tackle the teaching of mushroom growing. If only mushroom growers up and down the country would cease being so secretive about their industry and offer their services like Mr. Allen did, we should find no difficulty in giving training to those who want to learn about the growing of this crop. It is no good forcing men to learn ; the great thing is to take those who ask to be helped with a subject and then to give them of your best. We try and take infinite trouble with those who desire information on the subject, and this is well repaid by the almost embarrassing appreciation shown.

Expert mushroom growers may think we are doing very little, but after all we are not attempting any vocational training as such in the Army. We are merely trying to give the men and women the right ideas, and it is when they come out of the Army that they have to take their vocational training through the Ministry of Labour and the Ministry of Agriculture. It may be that some of the mushroom growers who read this article will be willing to take on an ex-soldier and train him under the scheme, and if so, full particulars can be obtained from the special training officer that the County War Agricultural Committees have appointed in most cases for this purpose.

May I end by wishing the Mushroom Growers' Association every success in the future.

A GROWER CONSIDERS ★ RESEARCH ★

by
M. C. LUXMOORE

THERE is at present an ever increasing desire that Science shall come to our aid and solve a number of problems that beset us. Two questions face us :—

1. How far do we as growers expect and hope science will help, and in what departments of the industry do we most need its succour ?

2. If we gain this scientific knowledge are we prepared to become scientifically minded ourselves and to produce the data which must be the foundation on which our research will be based.

If we can decide and clearly define our wishes on these two points we shall at least prepare something concrete and definite on which science can make a start.

First, considering question 1.

Mushroom Growing has its scientific side yet it is undeniably an art. The two are divided but perhaps not so neatly and clearly that a hard and fast line can be drawn.

Taking a rough line between the two it might be argued that science should be called upon to elucidate the mysteries of disease. It may readily dispose of Plaster Mould, Verticillium, Mycogone, Fly and Mite.

Science will undoubtedly give us an artificial compost, if it has not already done so, but my bet is that it will be a long time before it gives us one as good as the horse provides, unreliable though it seems to be. But a sure cure for Verticillium or Mycogone will save us many pounds and many sleepless nights.

On the other side of the rough line, the exact method of composting successfully, and such questions as why beds cease to crop when virtually so small a supply of available food has been used, or even the age old chestnut of contamination, will not be so easily solved.

URGENT PROBLEMS FIRST

An artificial compost packed in neat tin boxes and capable of a certain 2½ lbs. to the sq. ft. is going to throw half of us out of business and make it as easy for the amateur in his back garden as it is at present for him to produce tomatoes for his household.

In any case funds for such a course will have to be enormous if real results are to be obtained.

It might be propitious to watch America. The money is there and they are inclined to do things on a vast scale, with which we cannot hope to compete. Meanwhile, if either the Government or we ourselves as growers are to finance research, let that research be directed to more local and immediate problems, such as the curing of disease and the killing of the invaders.

A solution of these difficulties is what I expect of our research at present.

Mechanisation, too, I want and expect. It is time to kill the bugbear of dung slinging, and the labour entailed in filling a house.

So to the second question : Are we prepared to become scientifically minded ?

In this year of grace we probably recognise that the bell has tolled and that if we are to be successful growers of the elusive fungus we must be scientific, whether we like it or not.

As a first, though important step, I would advocate a real, live and wholehearted backing of the M.G.A. For some years we have been waiting for a lead. This virile little organisation has given it us. We cannot afford to neglect it, and merely to be passive about it is not enough. It stands for modern thought and a will to surmount obstacles.

SCIENCE NEEDS RELIABLE DATA

Again, if research is to help us it will likewise need our help. A doctor cannot cure a patient unless he tells him where and when and how the pain seizes him.

Science needs data, and reliable data at that. Undoubtedly the simplest data concerning mushroom growing is extremely difficult to come by. We differ amongst ourselves in all branches of the industry. We are all familiar with growers' preferences and each has its advocates and each is based on sound reasoning.

How many superstitions are we plagued with ? Stallions, the waxing of the moon, the layman's certainty that they mature overnight, even growing in the dark ; a shade of truth no doubt in them all, yet they all help to cast a mantle of darkness over our growing.

Superstition I feel, is the first cause in our diffidence in the sharing of real knowledge that indeed must abound amongst growers. The second is competition and needs no further comment. The third has been in the past the method of gaining information as to how other growers are faring.

Before the existence of the Bulletin the information we acquired was with few exceptions second-hand and liable to be distorted and based on guess work, especially if it concerned how much and how many. Who knows, for instance, the average lbs. to the sq. ft. cropped in this country ? It is at the moment a matter of pure conjecture. I was interested to see it quoted for the U.S.A., that it has been brought up from 1lb. to 1½ lbs. Few of us would admit to 1 lb., and one hears much more often of 2 and 2½ lbs. But this figure is surely a most important one from both scientific and unscientific points of view. The remedy is in our own hands. Might we well not start by sending to the M.G.A. our average yield for the past 12 months, under secret cover if you like. We might even have a sweepstake on the result. I only hope I draw somewhere near the 1 lb. mark. The result will at least tell us if we are reaching for the moon.

" Are the Essex mushroom growers merely deluded when they say that mushrooms wax with the waxing moon and shrink as the moon wanes ? They ought to know."
—*The late John o' London.*

R. L. EDWARDS, Ph.D., F.R.I.C.
Director of Research, M.R.A., Yaxley

Dr. R. L. EDWARDS

INTRODUCES THE

MUSHROOM RESEARCH ASSOCIATION

★

THE FIRST LABORATORIES AND PROGRAMME DEVOTED EXCLUSIVELY TO MUSHROOMS IN THE BRITISH ISLES

★

MEMBERS of the Mushroom Growers' Association are already familiar with the circumstances which led to the Midland Group's proposal to start its own research station.

A Research Association has now been formed as a company limited by guarantee, and as a result of invitations to the M.G.A. to join in its efforts it has, at the time of writing, thirteen subscribers with others joining every week. Contributions have also been received from firms who are interested in the industry, though not as commercial growers. Invitations have also been dispatched to every known grower in the country. The laboratory building at Yaxley is already in use, and most of the equipment has arrived, but delivery is still slow, and some of the more difficult items are still to come. Two " Handcraft " Huts are being erected and fitted out for use as growing houses. They are provided with extra insulation and false roofs to improve temperature control. The composting shed will have bays to hold a number of small heaps so that experimental composts can be made and compared side by side.

A staff of six is now engaged on the manifold preliminaries to the programme of research which has been drawn up. Two of them, the Director and Secretary, have been fully occupied with this work since January. They have been joined by a Microbiologist and a Chemist, both well qualified with experience in research, and by a trained laboratory assistant. A foreman with several years experience in a modern mushroom farm has also been engaged.

The first few months will be mainly occupied in standardising methods of sampling, analysis and similar operations which must be adapted to suit the mushroom growers' materials for routine use.

LABORATORY AND EXPERIMENTAL WORK

As a circular issued to members of the Mushroom Growers' Association has already indicated, the first place in the programme is given to the study of synthetic composts, which is considered the most urgent problem facing the whole industry.

Laboratory work and small-scale cultivation will be carried on simultaneously, so that the chemical and physical changes occurring during the preparation of experimental composts and the growth of mushrooms under various conditions can be continuously investigated, and related to the crops produced.

Arrangements are in hand for similar observations to be made on material from commercial farms, so that experimental work can always be compared with normal practice.

All composting and growth experiments will be reproduced at least three times, modern statistical methods being used to obtain the best average results and an estimate of their reliability. Composts will generally be made up in about 8 cwt. batches, to fill a 20 sq. ft. bed and provide a small surplus for other purposes. Growth experiments which do not require a compost separately prepared will generally be carried out first on small 2 sq. ft. plots, each being reproduced up to six times. The most promising treatments selected in this way can then be repeated with 20 sq. ft. beds, to confirm the result of the small scale test.

Other problems suggested by the research staff as a result of their experiments, or by members of the Research Association, will be submitted to the Board of Directors who will decide the order in which they are to be dealt with.

It is a normal part of the work of any research organisation to maintain touch with new developments and research in its industry and in allied fields of science. Relatively little experimental work has been done on mushrooms during the war, but more may be expected in the next few years, particularly in America. The research laboratory will follow such work as it is published and by private contact, and will circulate to its own members periodically a review of items likely to interest the commercial grower.

LABORATORY SERVICE FOR M.R.A. MEMBERS

It would be presumptuous with a staff of newcomers to the industry, however well qualified as scientists, to offer immediate advisory service to growers with years of experience, and Research Association members will probably find that more help on practical cultivation can be obtained through the Mushroom Growers' Association mutual aid scheme.

However, it is the ambition of the research station to attain as quickly as possible a position where it can give useful advice based on a combination of practical experience and scientific methods. Meanwhile, enquiries from members of the Research Association will

be welcomed and every effort will be made to answer those which call for scientific treatment rather than long experience of growing mushrooms. Questions which call for laboratory work on a scale likely to encroach on the research programme will have to be deferred for future consideration.

General observations on conditions of cultivation will be made throughout all experiments, and although a detailed study of Pests and Diseases must be deferred, observations on these subjects and on the merits of fungicides and insecticides will be made as time and opportunity permit. *May*, 1946.

FOOTNOTE *by* FRED. C. ATKINS

As Secretary of the Growers' Association and a Director of the Research Association, I have been asked by the Editor of this Bulletin to clarify three important aspects of this new venture.

1. It has come to my notice that several growers have been deterred from joining the Growers' Association under the impression that the annual subscription was £15 per 1,000 sq. ft. of available cropping area. Members would perform useful service if they emphasised in conversation with non-members that the annual subscription to the Growers' Association was £3 3s., and that the Growers' Association was in *no way whatsoever* connected with the Research Association.

2. The biggest obstacle still facing the Research Association is the high annual contribution required. There is only one way of overcoming it, viz.—more contributors. There exist no statistics of the bed-area to be put down to mushrooms this year of course; and in view of the limited response to the preliminary circular-letter relating to research, it was felt that £15 per 1,000 sq. ft. would be the lowest possible contribution. Even that is inadequate at the moment. On the other hand, if every member of the Growers' Association, for example, were to join the Research Association, the average contribution would be £28. And if as many growers as this were contributing, there is every reason to believe that a £ for £ grant might be available from the Government, reducing the annual average contribution to £14.

At any rate, if growers who are willing to consider participation on this basis would write to Dr. Edwards, a considerable reduction in the basic contribution might be effected. A fact which may have escaped the notice of some members is that if the 1,000 known Mushroom Growers in the British Isles could be persuaded to subscribe, the individual subscription need be no more than £4 4s. 0d.

3. To those who ask why an expenditure of £4,000 a year is necessary, I would point out that effective research would be impossible at a lower figure. The past has taught us the dangers of too narrow limits.

A large proportion of the annual expenditure goes in salaries, particularly to the qualified scientists. The work could not be done adequately or efficiently with a smaller staff.

* * * * *

"Careful study of Scientific data and the practical application of the valuable knowledge available to the grower are indispensable to the successful commercial cultivation of mushrooms." —VICTOR BRAUTIGAM in *The Grower*.

SCIENTIFIC PAGE

EXTRACTS FROM THE M.G.A. BOOKSHELF

Future Bulletins will contain abstracts from or reviews of new books and papers as they are obtained

A HIGHLY technical study by Treschow of the **NUTRITIONAL REQUIREMENTS** of cultivated mushrooms has now reached this country in an English translation. It is stimulating to the grower, but there is little he can do about it ; to research workers, it is obviously a publication of the greatest significance.

Treschow supports the contention that calcium is an indispensable nutrient " at any rate for the cultivated brown mushroom." He discovers that " even very small amounts of calcium have an extraordinarily strong physiological effect," and it " has a very important function as antagonist to potassium and magnesium." Mushroom mycelium " is very sensitive to too high phosphate concentrations "—which will be agreeable reading for Pizer and will startle some Americans.

Increased vigour in mycelial growth is demonstrated by the addition of small amounts of iron to a standard formula without iron ; and I wonder what Stoller will have to say when he reads that " under the given experimental conditions no effect could be observed from other trace elements."

Tantalizing vistas are opened by the statement that certain " growth substances " have a marked effect on mushroom development. Just before he left Long Ashton last year, Swarbrick was telling some of us he would be surprised if synthetic hormones were not destined to play an important part in the future of the mushroom industry. Treschow discovers that, although composted horse-manure already contains a considerable amount of growth substances, " a not inconsiderable increase in yield " follows the addition of further quantities.

When he reads that the average increase in one complete series of experiments with white mushrooms was in the fantastic neighbourhoods of 38.4% with Vitamin B, 28% with aneurin, and 45% with biotin—then the grower must surely ask himself afresh : Can I really afford to stand aside from Research ?

—TRESCHOW, CECIL : Nutrition of the Cultivated Mushroom. Dansk Botanisk Arkiv, XI, 6, 180 p.p., 1944.

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Two species of **SCARABAEID BEETLE** (genus Aphodius), about one-third of an inch long, have recently been causing injury to mushrooms in widely separated localities, devouring large portions of the caps in June and July. Treatment of the casing with derris, pyrethrum or nicotine powders have had no effect, but many years ago large numbers were trapped at Cheshunt with mangolds, cut in half and placed cut-side downwards upon the soil surface.

—CHESHUNT Experimental and Research Station. Thirtieth Annual Report, 1944.

An interesting Bulletin by Davis on the **MUSHROOM MITE** is based chiefly on investigations carried out in Maryland in 1935-41, and is disappointing in that no reference is made either to D.D.T. or Gammexane, according to the abstract published by the Review of Applied Entomology in March. Preventative measures suggested include the prompt disposal of debris and litter, proper composting, drenching the composting floor with formalin or boiled lime-sulphur and water before putting down a new pile, scraping the composting floor clean after the compost has been transferred to the house, and spraying empty houses with boiled lime-sulphur and water about two weeks before filling. Two other suggestions possess inherent dangers holding a peak heat of 130-140° for 7-10 days, and opening houses for a week or more during the severe weather. Over 40 materials were tested as dusts and drenches, but few were satisfactory. An alcoholic extract of pyrethrum, sprinkled on producing beds, did not damage the spawn, and though it killed relatively few mites, seemed to act as a repelent ; in the laboratory it practically freed spawn of mites within two hours. Dichlorethyl ether and water (1:166), emulsified with gum arabic, and methyl salicylate and water (1:500), applied in the same way killed a large proportion of the mites in the beds and did not reduce the crop.

—DAVIS, A. C. : The Mushroom Mite, Tyrophagus lintneri (Osborn), as a pest of cultivated mushrooms. Tech. Bull., U.S. Dept. Agric. No. 879, 26 pp., 6 figs., 25 refs., Washington D.C., 1944.

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MYCOGONE PERNICIOSA destroyed 85% of a bed of white mushrooms near Copenhagen in the summer of 1942. Applications of Bordeaux mixture 1-1-50 to the beds between flushes at the rate of 1 gallon to 20 sq. ft. reduced the number of infected buttons by 90-100% without injury to the beds. Useful control was also given by a composition of 1.5% phenol and 80% mineral oil, using 1 gallon to 20 sq. ft., but the crop suffers and the harvest is retarded.

—TRESCHOW, C. : Control of Mycogone perniciosa on cultivated Mushroom plots. Friesia, ii, 4-5, pp. 232-238, 1942-1943.

F.C.A.

* * * * *

The cultivated brown mushroom ought to be designated as Psalliota bispora (Lge.) Schaffer & Moller f. avellanea (Lge.), the cultivated white mushroom as Psalliota bispora (Lge.) Schaffer & Moller f. albida (Lge.). The term usually employed, Psalliota campestris (L.) Fr. ought no longer to be applied to any cultivated mushroom, as this species probably never has been under culture.

—Dr. Cecil Treschow, of Copenhagen.

F.C.A.

Many letters, Questions etc., meant for the Bulletin are being sent to the Secretary. Please note that Mr. Atkins is already overworked. Such communications should be sent to the Editor (address on page 5).

SITE CONTAMINATION

BY

M. H. PINKERTON

MUSHROOM-PLANT-CONTAMINATION is one of the major problems in mushroom growing today. Not only is it difficult to find a solution, but each plant, differing from its neighbour in design and method of working needs that solution adapted to its individual requirements. It is the purpose of this article to discuss various methods of laying out and running a mushroom plant and the accompanying disadvantages, and to suggest ways of dealing with them.

Theoretically, one of the simplest plans for growing disease-free crops is to fill the whole plant at once, grow the crop to a finish and then sterilise the entire premises thoroughly, thus ensuring a clean start for the next crop. Further precautions that may be taken are to disinfect all new material brought on to the plant, and to ensure that no person fresh from visiting other mushroom plants comes in contact with the now disease-free premises.

With many growers however, this is not possible. Some may not be able to obtain sufficient manure at one time to fill all their houses. Others find their labour program badly unbalanced, so that they have not enough workers at the height of the cropping season, and men standing idle at other times. There is, furthermore, loss of time in sheds lying empty while the manure accumulates and is composted, and a further time-lag between the filling of the first and last houses. The fluctuation in the price of mushrooms must also be considered, as the grower, putting all his crop on the market at once, might be unlucky enough to hit a low price period and would lose the advantage of spreading his crop over the season and at least gaining the average profit.

An alternative method, the continuous cropping system, in which the houses are filled in rotation, one at least being in production throughout the year, makes the control of disease very difficult. Many growers have houses in various stages of production in close proximity to each other. Tools, workmen and trucks which have been in contact with the spent and diseased mushroom beds may contaminate the new material for the next crop. Insects from the old beds travel to the new, carrying the spores of disease with them. In this way contamination gradually gains ground, until it is beyond the grower's control. What is to be done?

A THREE-SECTION SYSTEM

One system is to divide the plant into three sections, one empty and being sterilised, one being spawned and the third cropping. The labour and equipment must also be divided into three groups and as little contact as possible maintained between each section and its workers.

Even when this plan is scrupulously carried out however, insects may travel from one section to another, so that a program of insect control is essential. The grower himself in visiting the sections may carry disease with him—or the spores may be air-borne. Finally the scheme is so rigid and so unadapted to the vicissitudes of every-day life, and such strenuous supervision of the workmen is required to prevent contact between the groups and to prevent tools from one section being used in another as to make the scheme, if not impractical, at least extremely exacting.

This method can be simplified by painting the tools of the three sections green, red and blue and distinguishing the workers by coloured arm-bands. The first group deals with the composting and spawning and takes charge of each house until mushrooms begin to appear. Then the second group takes over, attending to the picking, packing and trashing, etc., until the crop is finished. The third group, which might be described as the decontamination squad, sees to the emptying of the houses, the disposal of the spent compost and the complete cleaning and disinfecting of the house and surroundings, making everything ready for the next crop. It is obvious that this scheme is not practical for everyone, especially for the small grower as such specialisation of the labour and tools is not an economical way of working. The supervising of such a system would in itself be a whole time job.

Of the two schemes outlined here, much can be said for and against each. It could be held that not one of them is adequate but that a combination of them, modified to suit the circumstances of the moment would be most effective.

For instance, at certain times of the year conditions are not entirely favourable for mushroom growing, perhaps because the market price falls so low as to make production unprofitable, or because the supply of good manure fails, or because the plant is in a part of the country where the summer temperature makes mushroom growing impossible without an expensive cooling system. Such occasions might be seized to close the plant and sterilise the premises completely, the continuous cropping system or the three section system being worked for the rest of the year.

PREVENTION IS BETTER....

Again it might be argued that the continuous cropping system with all its advantages of steady outlay, steady returns and steady labour demands can be made perfectly feasible by the exercise of certain precautions in the daily work of the plant, and certainly much can be done along these lines.

Before bringing the new material for the next crop to the premises, attention can be given to the complete disinfection, not only of the composting yard, but also of the trucks which are to carry the manure —an important point, as the same trucks may have been recently used to carry spent compost away from the plant.

The placing of the composting yard as far from the mushroom houses as possible, to prevent insects from the houses in production from contaminating the new material with disease spores and from laying their eggs in it, is worth trying. Consideration could also be given

to the direction of the prevailing wind and the plant arranged so that the wind blows neither from the houses to the composting yard nor vice-versa but cross-ways, so that air-borne disease spores are carried clear away from the plant.

After filling the houses the maintenance of a peak heat of 130° F. for about 18 hours is sufficient to kill most disease spores except truffle and most insects and their eggs.

A good vigorous run of spawn is another step in the campaign, as, if the spawn gets away to a good start, disease has not the same opportunity of gaining a hold on the beds.

Casing soil has frequently been found to be the source of certain mushroom diseases, so the sterilisation of the soil either by steam or by sterilising agents is a good safeguard.

Regular insecticide treatments twice weekly, the maintenance of even temperature, proper ventilation and careful moisture control also play a major role in such a program, as under hot moist conditions disease is encouraged.

SCRUPULOUS CLEANLINESS

Finally, by keeping the plant exceptionally neat and tidy; by seeing that the beds are properly trashed after each picking; by having all diseased mushrooms removed and burnt as soon as they appear; by not permitting the trashed material to lie in some forgotten corner—a perfect breeding ground for trouble; by sterilising at regular intervals and particularly at the beginning of each flush, the knives, trashing baskets, shed doors and all material in contact with the growing houses; by using no second-hand packing material which might bring disease from another part; by removing the spent compost as far from the plant as possible and disposing of it where future supplies of casing soil are not likely to be sought; by these and many similar precautions a grower may hope to carry on production and avoid trouble.

The flaws in this scheme are only too obvious. In the first place in spite of all this care, disease may still get a hold of the crop, for unflagging supervision would be needed to see such a program thoroughly carried out. Furthermore, there is nothing to prevent a rival grower with perhaps a better system of working his plant from carrying out all these precautions too—indeed he probably will do so—and so gain an added advantage over his less fortunate rival.

It is points like these which perplex the mind of the mushroom grower today. Whether some super scheme will be evolved which will solve the problem for everyone for all time, or whether even a master plan would have to be modified to suit a particular plant remains to be seen. In the meantime, the question is still being debated—what is the wisest plan?

* * * * *

"The Mushroom Growers' Association—that comparatively recent but energetic and enterprising society." From the *B. & G. Review.*

Please address all communications in connection with this Bulletin to the Editor (address on page 5)

FUSARIUM

"DAMPING OFF"

BY

C. P. WHITAKER, M.B.E., M.C.

CHAIRMAN OF THE M.G.A.

MUSHROOM growers have often suffered loss through a disease known to them as "damping off." Wood (1,2) has established that this disease is caused by members of the *Fusarium* species of fungi which are natural inhabitants of soil, and that the most common species to cause symptoms of the disease are *Fusarium martii* (App. & Wr.) and *F. oxysporum* Schl. During the course of Wood's investigations *Fusarium culmorum* (W.G.Sm) Sacc., *F. flocciferum* Cda., *F. redolens*, *F. sambucinum*, and other species were also isolated from infected specimens.

The disease should be suspected when the symptoms described below are observed, but, in order to isolate and confirm the disease, it may be necessary to plate out soil particles surrounding the bases of infected mushrooms on culture plates. The technique is described by Wood (2). This, however, can only be done in a laboratory, and, unless a grower has the necessary equipment, the opinion of a mycologist should be sought.

SYMPTOMS

The symptoms usually appear towards the end of a crop or following a period of heavy cropping. Although some of the mushrooms appear perfectly normal even to maturity, when picked, the interior of the stalk is dry and pithy, and often brown. Some mushrooms exhibit a characteristic glossy appearance as though the cap had been polished, the colour is darker than that of a normal mushroom, the interior of the stalk is dry and pithy shewing a dark brown or blackish colour extending upwards from the base of the stalk. Small, withered, and stunted mushrooms which remain almost indefinitely in a mummified condition on the beds may be found. Mushrooms exhibiting any or all of these symptoms may alternate with perfectly healthy specimens, but, even if they are picked off, the disease reappears and quickly spreads throughout the bed.

EFFECT OF THE DISEASE

The disease affects the market value of even slightly infected mushrooms, and renders the remainder a total loss. Heavy infection will cause the crop to be small and stunted from the outset and quite useless for sale. The production of mushrooms is not seriously affected by the disease.

CONTROL

Wood (3) has demonstrated that a mutual antagonism exists between the mycelia of the various species of *Fusarium* and *Agaricus* (Mushroom) and that, if due allowance be made for the relatively

slower growth of the mushroom mycelium, the latter is intensely antagonistic to *Fusarium*. Thus, a healthy, well established spawn run may overcome the effects of slight *Fusarium* infection. Usually, however, casing of beds takes place about a fortnight after spawning and production of mushrooms begins some three weeks or so later, consequently, if present, *Fusarium* may spread unchecked during this time. It is essential, therefore, to ensure that infection of the casing soil is reduced to a minimum, consistent with the practical and economic limits imposed by commercial practice. To this end two general alternatives present themselves. One is to sterilise already infected casing soil, and the other to use only non-infected material.

There are a number of ways of sterilising infected soil, but it is generally agreed among growers of mushrooms that some form of heat treatment is the most practicable. On a laboratory scale, it is quite possible to kill all the soil micro-organisms by this method but, on a commercial scale, it is almost impossible to ensure that the great bulk of soil required is really sterile and that all the spores of Fusarium are killed. The advisability of sterilising top-soil for subsequent use in casing is questioned by some growers who maintain that an almost sterile medium is formed in which, if later infected, any disease spores can germinate and develop free from interference from antagonistic micro-organisms.

The other alternative, to use only non-infected material, is not so impossible as it appears at first sight for, if sub-soil is used, from which the top-soil has been carefully removed and provided all reasonable precautions have been taken to prevent infection of the exposed material, it will be found that a casing soil reasonably free from *Fusarium* infection is obtained. The use of unsterilised sub-soil, in the case of one large grower, has completely replaced the use of steam sterilised top-soil and " damping off " has thereby been practically eliminated from his mushroom beds.

Assuming that all possible precautions have been taken to reduce the chances of *Fusarium* infection of the casing soil, what more can be done to check the development of any *Fusarium* present between the time of casing and the establishment of a vigorous mushroom mycelium growth in the soil? Wood (3) noticed that where " damping off " took place at the commencement of the crop, the following factors were consistently present :

1. A heavy clay soil which had been finely screened. This soil coheres on watering and the temperature of the house causes it to dry into a hard crust through which air cannot penetrate, thus adversely affecting the growth of the mushroom mycelium.

2. Lack of ventilation.

The casing soil should not be too finely screened. Various authorities recommend screening through sieves of from $\frac{3}{4}$ in. to $1\frac{1}{4}$ in. in size. If a heavy clay soil must be used, sand and lime should be thoroughly mixed in with it some few days before casing. This will improve the texture and prevent the formation of a hard crust over the compost. Ventilation is of great importance, and growers should take all possible measures to ensure that all stale air pockets in their houses are eliminated

and that efficient ventilation, without draughts, is provided. The human element is very important, for lack of hygiene may undo all the good the recommended measures have done.

Summary

" Damping off " disease is caused by various species of *Fusarium* normally present in the soil. The effect is not to stop production of mushrooms, but to render the crop valueless. Control measures consist of obtaining reasonably *Fusarium*-free soil at the outset and, recognising the antagonism that exists between *Fusarium* species and *Agaricus*, in producing conditions so that the spawn gets a flying start and outgrows what residue of *Fusarium* there is present. Strict attention to ventilation and to hygiene is essential. Spores of the disease can be introduced by clothes, boots, hands, and tools of insanitary workers as well as by insects and wind-borne soil or dust particles from infected areas.

1. 1935, Wood, F. C. A New Disease of Cultivated Mushrooms. Gard. Chron. XCVII, pg. 243.
2. 1937, Wood, F. C. Studies on " Damping off " of Cultivated Mushrooms and its association with Fusarium Species. Phytopath. XXVII, pp. 85-94 illus.
3. 1939, Wood, F. C. Studies on " Damping off " of Cultivated Mushrooms and its association with Fusarium Species II. Phytopath. XXIX, pp. 728-739 illus.

Due acknowledgement is given to F. C. Wood, whose works, detailed above, have materially assisted in the compiling of these notes.

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